Genetic network programming-reinforcement learning based safe and smooth mobile robot navigation in unknown dynamic environments

ABSTRACT

The problem of determining a smoothest and collision-free path with maximum possible speed for a Mobile Robot (R) which is chasing a moving target in an unknown dynamic environment is addressed in this paper. Genetic Network Programming with Reinforcement Learning (GNP-RL) has several important features over other evolutionary algorithms such as combining offline and online learning on the one hand, and combining diversified and intensified search on the other hand. However, it was used in solving the problem of R navigation in static environment only. This paper presents GNP-RL as a first attempt to apply it for R navigation in dynamic environment. The GNP-RL is designed based on an environment representation called Obstacle-Target Correlation (OTC). The combination between features of OTC and that of GNP-RL provides safe navigation (effective obstacle avoidance) in dynamic environment, smooth movement, and reducing the obstacle avoidance latency time. Simulation in dynamic environment is used to evaluate the performance of collision prediction based GNP-RL compared with that of two state-of-the art navigation approaches, namely, Q-learning (QL) and Artificial Potential Field (APF). The simulation results show that the proposed GNP-RL outperforms both QL and APF in terms of smoothness movement and safer navigation. In addition, it outperforms APF in terms of preserving maximum possible speed during obstacle avoidance.

Keyword: Genetic Network Programming with Reinforcement Learning (GNP-RL); Mobile robot navigation; Obstacle avoidance; Unknown dynamic environment